AN INLAND EMPIRE LONG-PERIOD RAINFALL RIDDLE [1]

By E. M. KEYSER

[Weather Bureau Office, Spokane, Wash.]

Spokane County in northeastern Washington and Bonner County in northern Idaho, adjoining on the State line, although meteorologically similar, hold quite contradictory long-period rainfall evidence. So positive and so opposite are the testimonies from these two sources, not over 75 miles apart, that we have a genuine long-time precipitation riddle. Both bodies of evidence indicate that the Inland Empire is unusually dry. However, one set of facts indicates the passage of a comparatively wet period and the recent arrival of a much drier period, while the other set indicates the approach of the end of a very dry period and possibly the time for a return to another wet period.

Inasmuch as future widespread industrial activities not only in the Inland Empire, but perhaps in other parts of the Pacific Northwest, would be most adversely affected by any further dessication, a knowledge of the underlying causes is most desirable. A great opportunity is open to meteorology and the sister sciences to analyze the present evidence and discover new facts and determine, if practicable, what Jupiter Pluvius may have in store for the "Spokane country" during the coming decades.

In this precipitation dilemma, the Spokane County testimony has been attractively brought to the attention of meteorologists in an article in the MONTHLY WEATHER REVIEW entitled, "Evidence of Prolonged Droughts on the Columbia Plateau Prior to White Settlement," by Dr. O. W. Freeman of Cheney, Wash. Vol. 57: 250–51.

His observations may be summarized as follows: Recent subnormal rainfall, particularly in 1926, has been attended in some of the lava bed lakes southwest of Spokane, by unusually low lake levels. The receding water has exposed to view stumps of pine trees originating at some unknown date in Silver Lake and Granite Lake. These stumps, now just above the low-water's edge, represent, as determined by a count of their rings, trees of as much as 100 years' growth. The argument is that during some prolonged drought prior to the coming of the white man the water levels of these lakes remained sufficiently low for a century or more for these trees to attain their growth, for such trees do not grow while standing in water. Then came the comparatively wet period from which we have in the last few years just emerged and raised the level of the water, submerging the lower portions of the trees. This high water, fluctuating in its surface level, not only killed the trees, but finally rotted them at the water line and the trees fell, leaving the present stumps. A well authenticated photograph taken some 20 years ago shows these trees were still standing in 1908. Now, the stumps remain in mute testimony of a dry cycle of at least a century. For such trees to mature would require a level considerably lower than the 1926 level. Well may we wonder when this part of the country was dry enough to allow such uninterrupted growth at such low water and whether the country is again going into still scantier rainfall.

In confirmation of the silent testimony of these stumps, the author calls attention to low water levels in eastern Oregon at Goose Lake, Malheur Lake, and Harney Lake in 1926.

In one dried up lake bed well defined wagon ruts were found, supposedly made by some pioneer in the forties since this floor of the lake has not been out of water since the region was permanently settled. If the presence of the stumps in these lakes is explainable from only a meteorological angle then the shrubs and saplings now invading the exposed bottoms may possibly be permitted to reach the ripe age of 100 years during a new dry cycle just now dawning and by the year 2050 A. D. be submerged by the next wet cycle and fare the fate of their present mute predecessors.

However, let us look to the other horn of our dilemma where indications point not to the immediate passing of a wet period but to the passing of a 40-year extremely dry cycle. This evidence from the Priest River drainage basin in Bonner County is of an undoubted meteorological character. It was called to the attention of students of forestry by Robert Marshall in an article in the Journal of Forestry.[2] Briefly presented it is this:

An exceptionally careful study of the ring growths of white pine trees near the Priest River Experiment Station with which Mr. Marshall for a while was connected convinced him that there have been in this section alternate wet and dry cycles of comparatively short lengths. For this study he selected five sets of different aged trees, viz, 70, 140, 180, 230, and 280 years old, using from 8 to 15 trees in each set for his averages. Trees were from well-drained soil and from locations affected as little as possible by other than meteorological conditions. His conclusions, graphically shown are that since the year 1675 when his first set of trees started there have been three distinct wet period and three equally distinct dry periods, varying in length from 20 to 39 years. His dry cycles were: 1746–1785, 1826–1845, 1886–1925; his wet cycles alternated from 1706–1745, 1786–1825, and 1846–1885. This study as stated took into consideration the fact that such items as temperature, sunlight, location, winds, fire, age, all exert an influence on growth of wood tissue. To confirm his selection of these cycles, the author used at least two independent checks.

Realizing that more trees start to grow during dry periods than in wet ones, he inventoried trees of three contiguous national northern Idaho forests with reference to the dates of their origin. He thus discovered that by far the largest percentage of trees, regardless of age considered, originated in his determined dry periods. The other check was that of history including the Spokane 45-year precipitation record since 1881. In the years of 1805 and 1806, Lewis and Clarke made notes on weather conditions to the effect that while in northern Idaho and western Montana during June, July, and August, there were 32 rainy days whereas we are now carrying a normal of 20; and that "it rained, as usual"; or that the Indians were setting fire to trees to "stop the rain." This occurred near the middle of the 1786–1825 wet period. Also it is noted that Washington Irving, historian, in relating the experiences of the Oregon pioneers, he quotes them as saying in 1834 that "all the plains and valleys were in one vast conflagration" and that the "mountains were enveloped in smoke" and that they had had difficulty in keeping together because of the

[1] Presented at the meeting of the American Meteorological Soc. at Eugene, Oreg., June 20, 1930.

[2] April, 1927.

smoke. We see that the year 1834 falls in the dry period of 1826–1845.

Not only does the Marshall graph of tree ring growth by pentads since 1675, by preponderance of evidence, support his determination of these brief, alternately wet and dry cycles, but it shows in a rather conspicuous way the degree of wetness or dryness. For instance, probably due to excessive rains or snows, comparatively heavy growth is shown for the periods 1706–1745 and 1786–1825. Very light growths were indicated for 1760–1770. But the most striking truth brought out in this tree-ring investigation is that in all ages of trees there has been a radical decline of tissue growth since 1885, except that this decline was materially halted in all ages of trees considered from about 1896 to 1902. This spurt of growth during the final decline is accurately reflected in the Spokane weather records for the years 1896 to 1902, which, despite a rather dry 1898, show average precipitation of 18.75, more than 2.00 inches above the present Spokane normal. Notwithstanding those recent seven wet years, Mr. Marshall concludes that the 40 years from 1885 to 1925, where his investigation ended, were by far drier than any similar period in the last 280 years.

Thus we find two neighboring counties, whose settings are meteorologically homogeneous, presenting diametrically opposite precipitation cycle evidence. The Granite Lake stumps point to a dry past of unknown origin terminating within the last two or three decades. The Priest River trees show no dry period in the last 280 years approaching in severity that of the last five decades. How could Granite and Silver Lakes trees grow at such low water levels while the Priest River Basin was enjoying heavy precipitation?

The proper solution of this enigma would be of much scientific interest as well as economic importance. Such a solution should without doubt consider the following.

Marshall's careful determinations of alternate wet and dry cycles by ring growth in more than 50 white pine trees in Bonner County are closely paralleled in similar determinations of ring growths in 23 Douglas firs 25 miles northeast of Portland, Oreg., whose age was approximately 210 years. From a table [3] by A. E. Douglas measurements indicate corresponding heavy growths in Marshall's wet periods and corresponding light growths in his dry periods. Between the white pine site in Bonner County and Granite Lake in Spokane County are numerous fresh water lakes now at unprecedented low water on whose banks ancient stumps are not revealed. This absence of old stumps on lakes to the north of Spokane needs adequate explanation. Is it not possible that the lava bed lakes now showing stumps have at some time in the past had a common subterranean outlet active at the time of the production of the old trees? Then also is it not possible that by some slight geological movement this outlet could have been in recent years blocked? Thus may these lakes have been filled and the trees killed. The present low water need not be accounted for by a reopening of the subterranean outlet, but by the general drought of the last few decades.

A complete solution of this riddle should take also into consideration a chemical analysis of the waters, and a study of the biology and geology of all the lava bed lakes. Also a correlation of the rings of the old stumps with those higher up on the slopes and with those of the Marshall white pines and the Douglas Oregon firs, while probably not likely to be convincing, would be of intense interest.

[3] See Climatic Cycles and Tree-Growth, by A. E. Douglas, Carnegie publication No. 289.

TULARE LAKE [1]—A CONTRIBUTION TO LONG-TIME WEATHER HISTORY

By C. E. GRUNSKY, Eng. D.

[1930]

In making a study of the water resources of the San Joaquin Valley, Calif., for the State engineer department, during the years 1881 to 1888, certain interesting facts were developed by the writer which should be more widely known, because they throw some light upon the weather conditions in Central California, or, more particularly, in the southerly San Joaquin Valley watershed, preceding any historical records. The facts to which attention will be directed relate to Tulare Lake which, during the last 30 years, has been repeatedly dry. In consequence of this condition the assumption is now generally made that the lake is a thing of the past; that its dry bed for the most part at least will remain dry hereafter.

That this assumption is premature and that the lake may at some unknown time in the future again attain a high stage will appear from a review of the history of the lake which had best be given by reference to the facts as they came to my attention. In 1881 and the years following I had occasion to make a number of visits to the lake region after having informed myself from maps and reports of the topography and behavior of streams in the watershed and in the immediate vicinity of the lake. It will be recalled in this connection that Kings River which drains a large watershed on the western slope of the Sierra Nevada Mountains, enters the San Joaquin Valley at a point easterly from Fresno. The course of the river across the valley, or, rather, across the broad east side plain of the valley, is southwesterly. At a point about midway of its course across this plain the delta formation of the river begins. The river, before its course was modified by human agency, sent some of its flood flow into numerous overflow or high water channels of which those toward the south discharged into the depression in which Tulare Lake lies and those toward the north were tributary to San Joaquin River. At low water stages, during the period when Tulare Lake is not overflowing, the discharge of Kings River is into the lake.

The delta of Kings River has been built up by the sand and silt which the river has brought into the valley, forming a broad flat-topped delta ridge which extends across the trough or lowest part of the San Joaquin Valley now appearing in the topography as a flat dam or barrier miles in width. Upstream or south from this barrier the original valley trough is at materially lower elevation than the lowest point on the crest of the ridge. A saucerlike depression has thus been formed upstream from the delta of Kings River. The water trapped in this depression forms Tulare Lake.

Probably 100 square miles of the lake bed are at about elevation 179 feet above mean sea level. The lake was at a very high stage in 1853 after several seasons with more than ordinary rainfall. Thereupon there was a

[1] Presented before American Meteorological Soc., Eugene, Oreg., June, 1930.